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Environmental Restoration Project Standard Operating Procedure

for:

Operation of LANL Owned Borehole Logging Trailer

Los Alamos

NATIONAL
LABORATORY

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Operation of LANL Owned Borehole Logging Trailer

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for operation and maintenance of the borehole video/geophysics logging trailer at the Los Alamos National Laboratory (Laboratory) ER Project.

2.0 SCOPE

This SOP is a mandatory document and shall be implemented by all certified operators when using the LANL owned borehole logging trailer for the ER Project.

3.0 TRAINING

The Field Team Leader (FTL) is responsible for ensuring that field team members who operate the LANL owned borehole logging trailer for the ER Project are certified by ESH-18 to operate the trailer tools and properly trained in the procedures of borehole logging. In addition, all field team members must document that they have read and understand this procedure in accordance with QP-2.2.

4.0 DEFINITIONS

Note: A glossary of definitions is located on the ER Project internal homepage <http://erinternal.lanl.gov>. Additional Mt. Sopris tool specific definitions can be found in the MSLog for the MGX II manual available at <http://www.mountsopris.com>.

- 4.1 Annular space or annulus—The space between the borehole wall and the casing, or the space between two concentric casing or pipe strings.
- 4.2 Borehole logging—The process of making remote measurements of physical, chemical, or other parameters at multiple depths in a borehole.
- 4.3 Caliper tool—A borehole logging tool used to measure the internal dimensions of a borehole or well casing.
- 4.4 Conductivity—The ability of a material to transmit an electric current. Conductivity is inversely proportional to the resistivity of the material.
- 4.5 Gamma tool—A borehole logging tool used to measure the natural gamma radiation emitted by the formation penetrated or by the introduced annular fill.

- 4.6 Induction tool—A borehole logging tool that measures formation conductivity by creating a magnetic field which in turn induces a current (Schlumberger, 1989).
- 4.7 Resistance—A function of both the resistance and geometry of the material being measured (Collier, 1993).
- 4.8 Resistivity—The ability of a material to resist the flow of electrons (current). Resistivity is inversely proportional to the conductivity of the material.
- 4.9 Single point resistance tool—A borehole logging tool that measures the resistance between two electrodes.
- 4.10 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or ER-related field activity that has been approved by an ER health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.
- 4.11 Spontaneous potential tool—A borehole logging tool that measures the voltage (potential) produced by the interaction of the formation water, drilling fluid, and certain ion-selective rocks (Schlumberger, 1989).
- 4.12 Video camera, downhole—A camera specifically designed to be lowered into a borehole for the purpose of visual inspection of downhole conditions.

5.0 BACKGROUND AND PRECAUTIONS

- 5.1 This SOP shall be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.
- 5.2 The first logging tool run in a borehole of unknown condition will always be the video camera.
- 5.3 In the event of equipment malfunction or uncertainty in operation of the trailer, the operator shall contact the Field Support Facility at 667-2876.
- 5.4 If video surveys indicate that borehole conditions are such that the potential for sticking or losing geophysical tools exists, then the operator shall consult with Field Support Facility personnel and Focus Area Leader before proceeding.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure.

- 6.1 Focus Area Leader
- 6.2 Team Leader
- 6.3 Quality Program Project Leader
- 6.4 Author
- 6.5 ER Project personnel

7.0 EQUIPMENT

A checklist of suggested equipment and supplies needed to implement this procedure is provided in Attachment A. Alphabetized descriptions of commonly used pieces of equipment, their advantages, and their limitations are listed below.

- 7.1 Defogging solution—A fluid applied to the lens cover on the video camera to prevent fogging while logging in an air filled borehole.
- 7.2 Lap top computer—A portable computer supplied by LANL required to run MSLog (Mt. Sopris Instrument Co., Inc. software).
- 7.3 MSLog software—The software required to run the Mt. Sopris Instrument Co., Inc. geophysical tools.
- 7.4 O-Ring lubricant—A product, such as Vaseline brand petroleum jelly used to condition the the rubber seals on the borehole logging equipment.
- 7.5 Thread locking compound—A product such as "soft" or blue LOC-TITE used to prevent unthreading of the caliper arms.
- 7.6 VHS tape—Standard video recording medium used in downhole video camera logging.

8.0 PROCEDURE

Note: Before individuals may utilize this or an equivalent standard operating procedure (SOP), they must be certified by ESH-18 to operate the borehole tools.

Note: Subcontractors performing work under the ER Project's quality program may follow this SOP for the use of the LANL owned borehole logging trailer or may use their own procedure(s) as long as the substitute meets the requirements prescribed by the ER Project Quality Management Plan, and is approved by the ER Project's Quality Program Project Leader (QPPL) before the commencement of the designated activities.

Note: ER Project personnel may produce paper copies of this procedure printed from the controlled-document electronic file located at http://erinternal.lanl.gov/home_links/Library_proc.shtml. However, it is their

responsibility to ensure that they trained to and utilize the current version of this procedure. The author may be contacted if text is unclear.

Note: Deviations from SOPs are made in accordance with QP-4.2, Standard Operating Procedure Development, and documented in accordance with QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities.

8.1 Running the Borehole Video Camera System.

- 8.1.1 Make sure that all power is off on the camera control and winch control box.
- 8.1.2 Put together camera system. There are two camera systems; a smaller diameter camera capable of viewing down only and a larger diameter camera capable of viewing both down and to the side. ALWAYS RUN THE SMALLER CAMERA SYSTEM BEFORE RUNNING THE LARGER SYSTEM. Assembly instructions are the same for both cameras.
 - 8.1.2.1 Lay camera on surface provided on the end of trailer.
 - 8.1.2.2 Place petroleum jelly on the O-ring at the end of the cable head. Rotate camera onto the cable head. DO NOT rotate the cable head or winch line.
 - 8.1.2.3 Place metal centralizer on the camera. Screw each end in tightly. Adjust diameter as needed.
 - 8.1.2.4 Place bottom light source on camera carefully. Insert plastic lock ring in the opening where the camera meets the light source. You may add petroleum jelly as a lubricant, if necessary.
 - 8.1.2.5 Carefully carry camera to borehole and hang vertically on a pulley.
- 8.1.3 Power up trailer.
- 8.1.4 Turn on winch control system which is the black CE box on counter above winch drum.
- 8.1.5 Turn LAMP VOLTAGE DOWN knob on the Laval R-10 control unit to the vertical position. (Putting voltage at a medium setting). Also, turn selector knob to position number 2: camera voltage.
- 8.1.6 Turn power on for the camera control system, VCR, and monitor.
- 8.1.7 Connect the coaxial cable (located on the side of the winch system) from the center port to the "Camera Logging" port.

- 8.1.8 When the camera lens is at ground level, hit the reset button on the Laval R-10 unit. This will give a depth of 0' 0" on the monitor. Use the VERT and HORIZ switches to move the depth display location on the monitor.
- 8.1.9 Set depth on black CE box: Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" until 0 is displayed, "2" until 0 is displayed, and "1" until 0 is displayed). Push "E" (enter) and then "R" (reset). Use "Disp" to toggle between depth and speed display.
- 8.1.10 Use the LAMP VOLTAGE DOWN and/or LAMP VOLTAGE SIDE knobs to change light intensity for a better view.
- 8.1.11 Use Black Mount Sopris CE Power box to move camera up and down the borehole. Flip switch to choose between up and down and adjust speed as needed. (maximum speed is approximately 40 feet/minute).
- 8.1.12 If the larger dual view camera is being used, front and side view can be changed using the VIEW FRONT/SIDE switch. The focus can also be adjusted with the FOCUS switch.
- 8.1.13 If the larger dual view camera is being used, the ROT START/STOP, ROT-DIR, and SPEED knobs will rotate camera and change rotation directions. DO NOT change rotation direction without first stopping the rotation.
- 8.1.14 To record, place VCR tape into VCR and hit the record button on VCR at anytime while using the camera.
- 8.1.15 When finished, make sure that all camera parts are deconed in accordance with ER-SOP-01.08, and placed back into the camera case. Close case and place back into the geophysics trailer.
- 8.1.16 Turn power off on the Mount Sopris Power Box, monitor, VCR, and Laval R-10 control unit. Finally, power down the trailer.

Note: Always use the buddy system.

Note: NEVER put together any parts on the camera while the power is on.

Note: DO NOT power up trailer while the R-10 power switch is ON.

Note: DO NOT hit the bottom of hole with the camera system.

Note: Always use the small camera to assess borehole condition before running the larger camera.

Note: Use common sense when selecting winch speed. Raise and lower camera slowly in unknown or unstable borehole conditions.

Note: For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Laval Underground Surveys R-10 and Color Cam 211 Instruction Books.

8.2 Running the Borehole Caliper Tool.

- 8.2.1 Connect caliper tool to the end of winch. The caliper tool requires both connectors.
- 8.2.2 Power up Trailer.
- 8.2.3 Connect the coaxial cable (located on the side of the winch system) from the center port to the "MGX Logging" port.
- 8.2.4 Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.
- 8.2.5 Connect computer to yellow box with attached serial cable and power up the computer.
- 8.2.6 Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
- 8.2.7 In the Tool window select "2PCA Caliper no PGA". This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.
- 8.2.8 Select caliper arm length. Long arms are for holes 10-in or greater in diameter. Short arms give greater resolution in holes with diameters less than 10-in. Caliper arms can be changed by gently opening the arms and propping open. Use wrenches to unscrew arms. Use "soft" or "blue" LOC-TITE on the threads to secure the arms in place. Tighten arms with wrenches.
- 8.2.9 Check tool calibration. Insert end of tool in the 10.19-in calibration disc and click "On" button on the Tool window. Turning the tool on opens the caliper arms. Click "Done" on Caliper operation window when the "Opening Caliper" timer window closes. In the Acquisition window click "On" while in the Time Sampling mode. If the computer reading is within 0.1-in, then the calibration is acceptable and proceed to 8.2.11). If tool is out of calibration, then leave arms open and proceed to 8.2.10).
- 8.2.10 To calibrate the caliper tool, right click on top bar of the MCHNUM window and turn off "Use calibration". Right click the bar again and select Calibration Settings. With tool still in the 10.19-in calibration disc click "Use Current" button in Second Point box. Manually close the arms and insert tool in the 3.51-in calibration disc. Click "Use

Current" in the First Point box then click "Store". Close the Calibration Settings window by clicking the "x" in the upper right hand corner. All browsers must be closed and restarted for new calibrations to take effect. Click on "Close All" button found on the Browsers & processors window. Select and Start all three browsers. Check calibration again.

- 8.2.11 TURN OFF TOOL and close caliper arms. Click "Off" button on Tool window. Turning the tool off closes the caliper arms. Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes.
- 8.2.12 Zero the tool: Set the top of the lower connector to the reference point (e.g. ground surface). Click on the upper right hand button on the Depth window to reveal the next window. Click on the "Zero Tool" button. Display on computer will read 5.53 (ft) and display on yellow box will read 5.5 (ft). Close large "Depth" window by clicking on "x" in upper right corner. Note: you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).
- 8.2.13 Set depth on black CE box: Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 5 is displayed directly above, "2" button until 5 is displayed directly above, and "1" button until 3 is displayed directly above). Push "E" (enter) and then "R" (reset). Use "Disp" to toggle between depth and speed display.
- 8.2.14 Move tool to desired depth. DO NOT LOG GOING DOWN! DO NOT TURN TOOL ON UNTIL READY TO LOG UP!
- 8.2.15 When tool is at desired depth power up by clicking the "On" button on the Tool window. Turning the tool on opens the caliper arms. Click "Done" on Caliper operation window when the "Opening Caliper" timer window closes. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.
- 8.2.16 Switch Sampling mode (in Acquisition window) to Depth up and click "On" button.
- 8.2.17 To record data: In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID. Click ok to close header window. Click Record button, enter file name, and select destination folder.

- 8.2.18 Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up.
- 8.2.19 At the end of the logging run, click the "Stop" button located next to "Record" button, then click "Off" button in Acquisition window, then click "Off" button in Tool window. Clicking "Off" button on Tool window will close the caliper arms. Click "Done" on Caliper operation window when the "Closing Caliper" timer window closes.
- 8.2.20 The tool is now powered down and can be detached from the cable head.
- Note:** DO NOT unhook the tool without turning off the power on the computer. As an additional precaution the yellow MGX II box may be turned off.
- 8.2.21 To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.
- 8.2.22 Unhook the caliper tool, clean it in accordance with ER-SOP-01.08, and place it back in the PVC tube and strap it into the storage rack. The lower connector or protective cap must be left on the tool for protection. Lower the boom and secure in the upright position. Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.
- Note:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II available at <http://www.mountsopris.com/>, 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PCA-1000 PolyCaliper Probe and 2CAA-1000 Caliper Probe, and MGXII Tool Specific Operations Mount Sopris Instrument Co., Inc. documentation.

8.3 Running the Borehole Conductivity/Resistivity (Induction) Tool.

- 8.3.1 Connect tool to the end of winch. The R/C tool requires both connectors.
- 8.3.2 Loosen set screw on bottom end cap and remove cap. Attach 16-in stainless steel weight and tighten set screw.
- 8.3.3 Power up Trailer.
- 8.3.4 Connect the coaxial cable (located on the side of the winch system) from the center port to the "MGX Logging" port.
- 8.3.5 Power up winch controls by turning the power switch to the "On" position on both the MGX II yellow logger control panel and the black CE control panel.

- 8.3.6 Connect computer to yellow box with attached serial cable and power up the computer.
- 8.3.7 Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
- 8.3.8 In the Tool window select "2PIA 0-1000ms no PGA attached". This will initiate the MchCurve, MCHNUM, and LASWRITER browser; and MSIPROC processor windows.
- 8.3.9 Zero the tool: Set the top of the lower connector to the reference point (e.g. ground surface). Click on the upper right hand button on the Depth window to reveal the next window. Click on the "Zero Tool" button. Display on computer will read 5.68 (ft) and display on yellow box will read 5.7 (ft). Close large "Depth" window by clicking on "x" in upper right corner. Note: you may confirm "zero point" by measuring the full length of the tool (bottom of the tool to top of lower connector).
- 8.3.10 Set depth on black CE box: Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" until 5 is displayed, "2" until 6 is displayed, and "1" until 8 is displayed). Push "E" (enter) and then "R" (reset). Use "Disp" to toggle between depth and speed display.
- 8.3.11 Power up by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode. Click "Off" to stop sampling.
- 8.3.12 With the tool still turned on, lower the tool into the borehole fluid. If no fluid is present, then lower tool to approximately 10-ft above bottom of borehole. Allow tool to equilibrate to borehole conditions for about 15 minutes. Remove tool from borehole.
- 8.3.13 Loosen set screw on stainless steel weight and remove. Replace end cap before calibrating.
- 8.3.14 Tool must be calibrated before each use. To calibrate the R/C tool, right click on top bar of the MCHNUM window and turn off "Use calibration". Right click the bar again and select Calibration Settings.
- 8.3.15 Assemble calibration coil: Screw gray PVC pipe into the side with the small dial of the large, flat, white calibration disc. Set dial to "0". Remove all metal from hands, wrists, arms, head, and neck. Hold tool vertically above head as far from any metal as possible. In the First Point box set reference to "0" and click "Use Current". Set dial

on calibration coil to "460". In the Second Point box set reference to 460 and click "Use Current" then click "Store". Close the Calibration Settings window by clicking the "x" in the upper right hand corner. All browsers and processors must be closed and restarted for new calibrations to take effect. Click on "Close All" button found on the Browsers & processors window. Select and Start all three browsers and the one processor.

8.3.16 Move tool to desired depth and switch Sampling mode (in Acquisition window) to Depth up or Depth down and click "On" button.

8.3.17 To record data: In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID. Click ok to close header window. Click Record button, enter file name, and select destination folder.

8.3.18 Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down.

8.3.19 At the end of the logging run, click the "Stop" button located next to "Record" button, then click "Off" button in Acquisition window, then click "Off" button in Tool window. The tool is now powered down and can be detached from the cable head.

Note: DO NOT unhook the tool without turning off the power on the computer. As an additional precaution the yellow MGX II box may be turned off.

8.3.20 To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.

8.3.21 Unhook the R/C tool, clean it in accordance with ER-SOP-01.08, and strap it into the storage rack. The lower connector or protective cap must be left on the tool for protection. Lower the boom and secure in the upright position. Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

Note: For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II available at <http://www.mountsopris.com/>, 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PIA -1000 Poly Induction Probe, and MGXII Tool Specific Operations Mount Sopris Instrument Co., Inc. documentation.

8.4 Running the Gamma Tool.

- 8.4.1 Connect gamma tool to the end of winch. The gamma tool requires only one connector. Centralizer may be added if borehole conditions warrant. Note: If you are going to use the SP/SPR functions in the Gamma tool, then you must wrap the cable head and adapter in electrical tape before lowering tool into the borehole.
- 8.4.2 Power up Trailer.
- 8.4.3 Connect the coaxial cable (located on the side of the winch system) from the center port to the "MGX Logging" port.
- 8.4.4 Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.
- 8.4.5 Connect computer to yellow box with attached serial cable and power up the computer.
- 8.4.6 Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
- 8.4.7 In the Tool window select 2PGA-1000 Gamma. This will initiate the MchCurve, MCHNUM, and LASWRITER browser windows.
- 8.4.8 Zero the tool: Set the top of the tool to the reference point (e.g. ground surface). Click on the upper right hand button on the Depth window to reveal the next window. Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft). Close large "Depth" window by clicking on "x" in upper right corner.
- 8.4.9 Set depth on black CE box: Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" button until 2 is displayed directly above, "2" button until 5 is displayed directly above, and "1" button until 9 is displayed directly above). Push "E" (enter) and then "R" (reset). Use "Disp" to toggle between depth and speed display.
- 8.4.10 Power up tool by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.
- 8.4.11 Move tool to desired depth (typically, collect data both as the tool is quickly lowered into the hole and more slowly as it is raised). In Acquisition window switch Sampling mode to Depth up or Depth down and click the "On" button.

- 8.4.12 To record data: In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID. Click ok to close header window. Click Record button, enter file name, and select destination folder.
- 8.4.13 Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down as appropriate.
- 8.4.14 At the end of the logging run, click the "Stop" button located next to "Record" button, then click "Off" button in Acquisition window, then click "Off" button in Tool window.
- 8.4.15 The tool is now powered down and can be detached from the cable head. If a Spontaneous Potential/Single Point Resistance log is to be run, then leave the tool attached, select 2PGA-1000 SPR, SP from the tool menu and refer to PROCEDURE FOR RUNNING A SPR/SP LOG.
- Note:** DO NOT unhook the tool without turning off the power on the computer. As an additional precaution the yellow MGX II box may be turned off.
- 8.4.16 To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.
- 8.4.17 Unhook the gamma tool, clean it in accordance with ER-SOP-01.08, and place it back in the storage box. Lower the boom and secure in the upright position. Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.
- Note:** For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II available at <http://www.mountsopris.com/>, 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, 2PGA-1000 Poly-Gamma Probe, MGXII Tool Specific Operations, MSLog v.6 for the MGX II, and MSLog v.6 for the MGX II Operator Manual.

8.5 Running the Borehole Spontaneous Potential/Single Point Resistance Tool

- 8.5.1 Connect gamma tool to the end of winch. The gamma tool contains the Spontaneous Potential (SP) and Single Point Resistance (SPR)

tools. The SP/SPR tool requires only one connector. Wrap the cable head and adapter in electrical tape before lowering tool into the borehole.

- 8.5.2 Attach Mud Plug to green port on side of the yellow MGX II box. Put Mud Plug into a conductive fluid such as the cuttings or mud pit (hence the name "Mud Plug"). If a pit is not available or the plug cable can't reach, then a hole must be dug and filled with water. The goal is to complete a circuit with the downhole tool through the ground.
- 8.5.3 Power up Trailer.
- 8.5.4 Connect the coaxial cable (located on the side of the winch system) from the center port to the "MGX Logging" port.
- 8.5.5 Power up winch controls by turning the power switch to the on position on both the MGX II yellow logger control panel and the black CE control panel.
- 8.5.6 Connect computer to yellow box with attached serial cable and power up the computer.
- 8.5.7 Double click on the MSLog icon to open the MSLog program. If dialogue boxes come up with a choice between using logger or computer settings, select logger settings and click ok.
- 8.5.8 In the Tool window select 2PGA-1000 SPR, SP. This will initiate the MchCurve, MCHNUM, and LASWRITER browser; and the MSIPROC processor windows.
- 8.5.9 Zero the tool: Set the top of the tool to the reference point (e.g. ground surface). Click on the upper right hand button on the Depth window to reveal the next window. Click on the "Zero Tool" button. Display on computer will read 2.59 (ft) and display on yellow box will read 2.6 (ft). Close large "Depth" window by clicking on "x" in upper right corner.
- 8.5.10 Set depth on black CE box: Hit "P" (program) then use buttons directly below digits to change display (e.g. push "3" until 2 is displayed, "2" until 5 is displayed, and "1" until 9 is displayed). Push "E" (enter) and then "R" (reset). Use "Disp" to toggle between depth and speed display.
- 8.5.11 Power up tool by clicking the "On" button on the Tool window. Tool box green light will come on when the tool is ready. Confirm that the tool is collecting data by clicking "On" in the Acquisition window while in Time Sampling mode.

- 8.5.12 Move tool to desired depth (typically, collect data both as the tool is quickly lowered into the hole and more slowly as it is raised). In Acquisition window switch Sampling mode to Depth up or Depth down and click the "On" button.
- 8.5.13 To record data: In Acquisition window click Header button and enter all available information. At a minimum enter bit from, bit to, bit, casing from, casing size, casing to, company, date, depth drilled, depth logged, level, location, recorded by, type log, and well ID. Click ok to close header window. Click Record button, enter file name, and select destination folder.
- 8.5.14 Begin logging. For best results, log at 15 ft/min or slower. Remember to switch Sampling mode to Depth up or Depth down as appropriate.
- 8.5.15 At the end of the logging run, click the "Stop" button located next to "Record" button, then click "Off" button in Acquisition window, then click "Off" button in Tool window. The tool is now powered down and can be detached from the cable head.
- Note:** DO NOT unhook the tool without turning off the power on the computer. As an additional precaution the yellow MGX II box may be turned off.
- 8.5.16 To close MSLog right click anywhere on the dashboard (windows along left side of screen) and exit.
- 8.5.17 Unhook the gamma/SP/SPR tool, clean it in accordance with ER-SOP-01.08, and place it back in the storage box. Detach the Mud Plug from the control box and from the pit. Clean the Mud Plug and return to storage. Lower the boom and secure in the upright position. Applying tension to the cable, walk it back onto the winch drum and secure the cable head to the boom.

Note: For more detailed instructions, maintenance, trouble shooting, and detailed diagrams, see the Operator Manual MSLog v.6 (or later) for the MGX II available at <http://www.mountsopris.com/>, 5MCA-1000 and 5MGB-1000 MGX II Loggers, WNA Winch, 3WCA-1000 Winch Control, MGXII Tool Specific Operations, MSLog v.6 for the MGX II, Computer Software (IBM-PC), MSLog v.6 for the MGX II Operator Manual, and 2PGA-1000 Poly-Gamma Probe documentation.

8.6 Lessons Learned

During the performance of work, ER Project personnel shall identify, document, and submit lessons learned in accordance with QP-3.2, Lessons Learned, located at: http://erinternal.lanl.gov/home_links/Library_proc.htm.

9.0 REFERENCES

ER Project personnel may locate the ER Project Quality Management Plan/ER Project QP requirements crosswalk at

http://erinternal.lanl.gov/home_links/Library_proc.shtml.

The following documents are cited within this procedure:

Schlumberger, "Log Interpretation Principles/Applications," Schlumberger Educational Services, Houston, TX, 1989)

Collier, H. A., "Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas," unpublished Doctoral Dissertation, The University of Texas at Dallas, 1993

Laval Underground Surveys, R-10 DUAL-CAM Downhole & Sideview Instruction Manual, Laval Underground Surveys, A Division of Claude Laval Co., Fresno, CA, 1995

Laval Underground Surveys, COLOR CAM 211 Instruction Manual, Laval Underground Surveys, A Division of Claude Laval Co., Fresno, CA, 1997

Mount Sopris Instrument Co., Inc., "5MCA-1000 and 5MGB-1000 MGX II Loggers," Mount Sopris Instrument Co., Inc., Golden, CO, 1995

Mount Sopris Instrument Co., Inc., "WNA Winch," Mount Sopris Instrument Co., Inc., Golden, CO, 1996

Mount Sopris Instrument Co., Inc., "3WCA-1000 Winch Control," Mount Sopris Instrument Co., Inc., Golden, CO, 1996

Mount Sopris Instrument Co., Inc., "2PGA-1000 Poly-Gamma Probe," Mount Sopris Instrument Co., Inc., Golden, CO, 1996

Mount Sopris Instrument Co., Inc., "2PCA-1000 PolyCaliper Probe and 2CAA-1000 Caliper Probe," Mount Sopris Instrument Co., Inc., Golden, CO, 1997

Mount Sopris Instrument Co., Inc., "2PIA-1000 Poly Induction Probe," Mount Sopris Instrument Co., Inc., Golden, CO, 1996

Mount Sopris Instrument Co., Inc., "4EMD-1000 Induction Probe Calibration Coil," Mount Sopris Instrument Co., Inc., Golden, CO, 1997

Mount Sopris Instrument Co., Inc., "MGXII Tool Specific Operations," Mount Sopris Instrument Co., Inc., Golden, CO, 2000

Mount Sopris Instrument Co., Inc., "MSLog v.6 for the MGX II," Computer Software (IBM-PC), Mount Sopris Instrument Co., Inc., Golden, CO, 1998

Mount Sopris Instrument Co., Inc., "MSLog v.6 for the MGX II Operator Manual," Mount Sopris Loggers," Mount Sopris Instrument Co., Inc., Golden, CO, 1995

QP-2.2, Personnel Orientation and Training

QP-3.2, Lessons Learned

QP-4.2, Standard Operating Procedure Development

QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities

ER-SOP-01.08, Field Decontamination of Drilling and Sampling Equipment

10.0 RECORDS

The **FTL** is responsible for submitting the following records (processed in accordance with QP-4.4, Record Transmittal to the Records Processing Facility) to the Records Processing Facility.

10.1 Borehole Log Electronic File

10.2 Borehole Status Form

10.3 Field Team Leader Field Log Book

10.4 Log Header Form

10.5 Recording of Borehole Camera Log

11.0 ATTACHMENTS

Attachment A: Equipment and Supplies Checklist for Borehole Logging

Attachment B: Borehole Status Form located at
<http://erinternal.lanl.gov/Quality/user/forms.asp>.

Attachment C: Log Header Form located at
<http://erinternal.lanl.gov/Quality/user/forms.asp>.

[Using a token card, click here to record "self-study" training to this procedure.](#)

If you do not possess a token card or encounter problems, contact the RRES-ECR training specialist.

[illegible]

BOREHOLE STATUS FORM

To be filled out by drilling engineer or site geologist

Logging Date: ____/____/____

Borehole / Well Name: _____

Contractor: _____

Well Status: ☐ Open Hole ☐ Completed ☐ Other _____

Number of Concentric Casing(s): _____ Current Borehole Depth _____ ft

Casing Top Depth						
Casing Bottom Depth						
Casing Inside Diameter						
Casing Wall Thickness						
Casing Type/Material						
Bit Size						
From						
To						
Cement Plugs						
From						
To						

Type of Fluid in Hole: _____ Level: _____ ft.

Casing Collars: ☐ Yes

Average Spacing: _____ ft.

Shoes: ☐ Yes

Other Materials in Hole:

____ From _____ To _____ ft.
____ From _____ To _____ ft.
____ From _____ To _____ ft.

Reason for running log:

Comment:

Form Completed By: _____

LANL Observer: _____

QA Reviewer: _____

LOG HEADER FORM

Fill out one form for each logging run

Logging Date: ____/____/____ Borehole / Well Name: _____

Contractor: _____ Operator: _____

Run Number: _____ Logging Vehicle Number: _____ ☐ LANL Logging Trailer

Log Type: ☐ Gamma Ray ☐ Gamma-Gamma Density ☐ Resistivity
☐ Temperature ☐ Fluid Flow ☐ Induction
☐ Hole Deviation ☐ Acoustic (Sonic) ☐ Spontaneous Potential
☐ Neutron ☐ Borehole Video ☐ Caliper
Calibration Matrix: *Number of Arms* _____

☐ Dolomite

☐ Other _____

☐ Limestone

☐ Sandstone

Electronic File Name: _____ Format: _____

Null Value (If Applicable): _____

Start Time: _____ End Time: _____

Measuring Point Description: ☐ GL (Ground Level) *Default to Ground Level when suitable*

☐ Other _____

Measuring Point Relative to Ground Level: _____ ft

Log Run Through: ☐ Casing ☐ Annular Space ☐ Tremie ☐ Open Hole

Bottom Log Depth: _____ ft Top Log Depth: _____ ft

Uniform Logging Speed? ☐ No Logging depth increment: _____

Quality of Log: ☐ Good ☐ Fair ☐ Poor

Quality Comment (Required for Fair or Poor): _____

Calibration Note: _____

Logger Remarks: _____

Form Completed by: _____

LANL Observer: _____

QA Reviewer: _____